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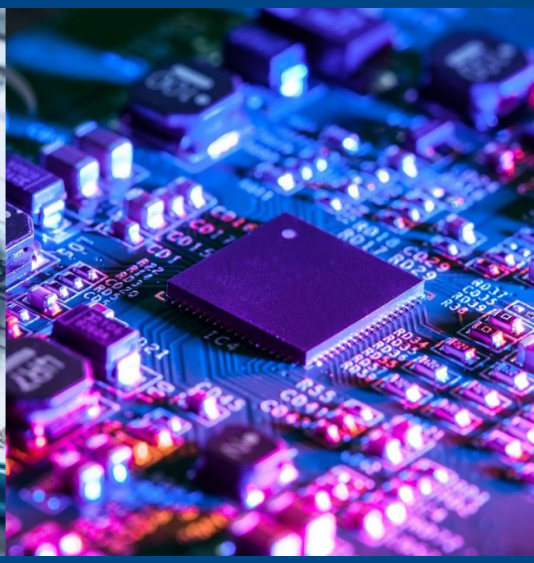

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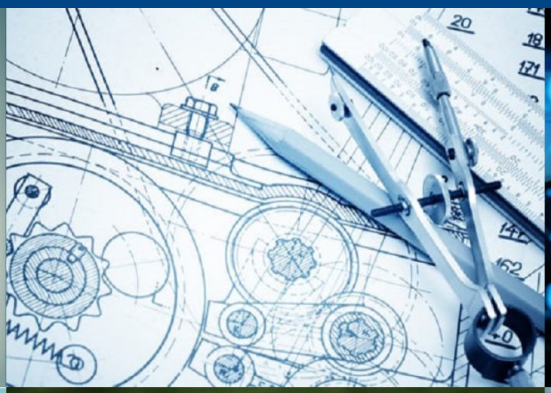

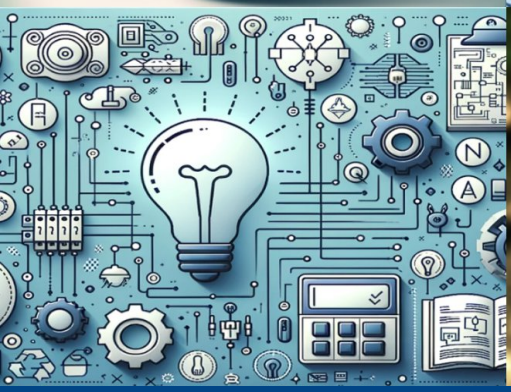

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Serverless Cloud Based E-Voting System Using Google Cloud Platform (GCP)

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ABSTRACT: Electronic voting systems are becoming essential for ensuring transparent and efficient elections in the digital era. This paper proposes a serverless cloud-based e-voting system built using the infrastructure of Google Cloud Platform. The system eliminates the need for traditional server management by utilizing cloud services that provide scalability, reliability, and security. Voter authentication, vote casting, and vote storage are implemented through cloud-based services such as Cloud Firestore and Firebase Authentication. The proposed system ensures that each voter can cast only one vote while maintaining data integrity and transparency. The architecture supports real-time vote storage and secure data management while minimizing operational cost through serverless infrastructure. The system is designed to handle large numbers of voters efficiently, making it suitable for small-scale elections such as campus or local community voting. By leveraging cloud technologies, the proposed system improves accessibility, reduces infrastructure complexity, and enhances the overall reliability of digital voting platforms.

KEYWORDS: Serverless Computing, Cloud Voting, Digital Election System, Secure Voting, Cloud Infrastructure, Scalable Voting Architecture.

I. INTRODUCTION

In modern democratic societies, elections play a crucial role in ensuring fair governance. Traditional voting methods often involve manual processes that can be time-consuming and susceptible to human errors. With the advancement of cloud computing technologies, electronic voting systems have gained significant attention as a reliable alternative. A cloud-based e- voting system can improve transparency, efficiency, and accessibility while reducing infrastructure costs.

The proposed system utilizes the capabilities of google cloud platform to build a serverless voting architecture. Serverless computing allows applications to run without managing dedicated servers, enabling automatic scaling and high availability. The system uses firebase authentication for secure voter login and cloud firestore for real-time database storage. Each vote is securely stored in the cloud, ensuring that voters can participate stored in the cloud, ensuring that voters can participate in the election process remotely while maintaining vote integrity.

The objective of this research is to design a scalable and secure e-voting platform capable of handling multiple voters simultaneously while ensuring transparency and realability

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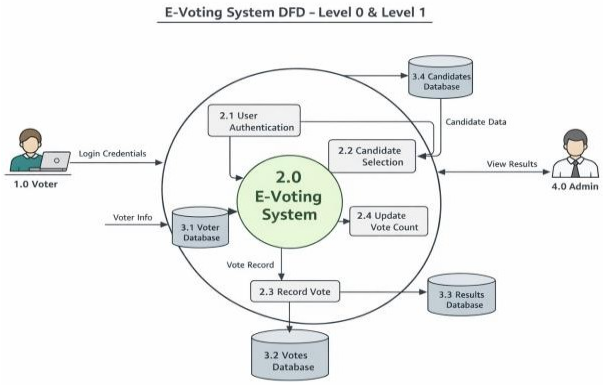

II. RELATED WORKS

Several studies have explored the development of secure and efficient electronic voting systems using modern web and cloud technologies. With the increasing demand for transparent and remote election systems, researchers have proposed different architectures and security mechanisms to enhance the reliability of online voting platforms.

Kumar et al. (1) proposed a secure online voting system implemented using web technologies. Their system focused on authentication mechanisms and secure database storage to ensure that only authorized users could cast votes. The research highlighted the importance of protecting voter credentials and maintaining the integrity of election data.sharma and verma (2) introduced a cloud-based e-voting system designed for academic elections. Their system utilized cloud infrastructure to manage voter registration, vote casting, and result generation efficiently. The study demonstrated how cloud computing can improve scalability and reliability during election processes.patel et al. (3) designed and implemented an online e-voting system that emphasizes accessibility and usability. Their system provided a simple interface for voters while maintaining secure storage of voting data. The research focused on improving the overall user experience while ensuring data integrity.rahman et al. (4) proposed a secure electronic votingsystem using token-based authentication. In this approach, unique tokens were generated for each voter to prevent duplicate voting and unauthorized access. This mechanism strengthened the security of the voting process and ensured that each voter could vote only once.zhang et al. (5) explored the use of cloud infrastructure for developing online electronic voting systems. Their work highlighted how cloud-based platforms can provide scalable, secure, and highly available environments for handling large-scale elections and managing voting data efficiently.

III.EXISTING SYSTEM

Traditional voting systems rely on manual processes where voters must physically visit polling stations to cast their votes. These systems require significant infrastructure, manpower, and time to conduct elections. Manual vote counting can also lead to human errors and delays in result declaration.

Some electronic voting systems use centralized server architectures to store and process voting data. Although these systems improve efficiency, they often face challenges such as server failures, security risks, and limited scalability. In addition, maintaining dedicated servers increases operational complexity and cost.These limitations highlight the need for a more scalable and secure voting system that utilizes modern cloud technologies.

IV.PROPOSED SYSTEM

The proposed system introduces a serverless cloud-based electronic voting platform designed to provide secure, scalable, and efficient election management. The system utilizes modern cloud technologies to ensure reliable vote processing and secure data storage.

A. Secure voter authentication

The system implements a secure login mechanism to verify voter identity before allowing access to the voting platform. This ensures that only authorized voters can participate in the election process

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B. Cloud-based data storage

All voting data, including voter information and vote records, are securely stored in cloud databases. Cloud storage ensures data availability, reliability, and protection against data loss.

C. Online vote casting

The proposed platform allows voters to cast their votes through a user-friendly web interface. Each voter can select their preferred candidate, and the vote will be recorded securely in the database.

D. Automatic vote counting and result generation

The system automatically counts votes in real time and updates the results accordingly. This reduces manual effort, minimizes errors, and ensures faster result declaration.

E. Scalable serverless architecture

By using a serverless cloud infrastructure, the system can automatically scale based on the number of voters. This ensures smooth performance even during peak voting periods.

V. SYSTEM ARCHITECTURE

The system architecture of the proposed serverless cloud-based e-voting system consists of multiple components that work together to ensure secure and efficient voting operations. The architecture is designed using cloud services to provide scalability, reliability, and secure data management.

First, the user interface allows voters to access the voting platform through a web browser. Voters can log in to the system, view the list of candidates, and cast their votes through a simple and user-friendly interface.Next, the authentication module verifies the identity of the voter before allowing access to the voting system. This step ensures that only authorized users can participate in the election process and prevents unauthorized access.

The application logic layer processes voting requests and manages system operations such as vote submission, validation, and vote counting. This layer ensures that each voter can cast only one vote.

Finally, the cloud database securely stores voter information, candidate details, and voting records. Cloud infrastructure provides reliable storage, automatic scaling, and high availability to support large numbers of voters during election periods.

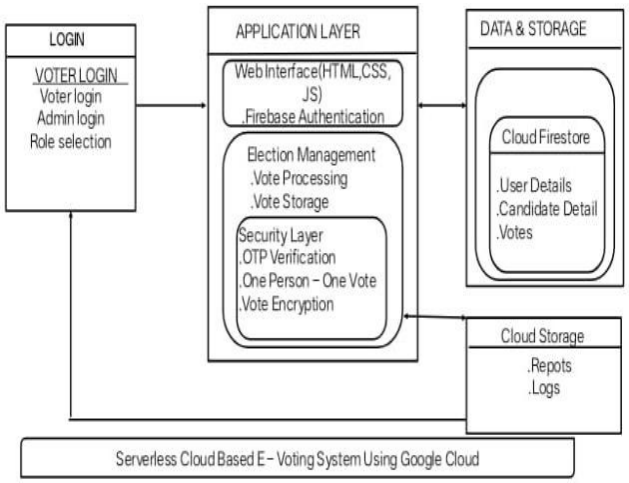

Fig. 1. Serverless E - Voting System Architecture

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VI.IMPLEMENTATION DETAILS

The proposed e-voting system is implemented using modern web technologies and cloud services to ensure efficiency and scalability. The frontend interface of the system is developed using html, css, and javascript to provide a simple and user- friendly environment for voters to access the platform.

The authentication module is responsible for verifying voter identity before allowing access to the voting page. Each voter logs into the system using unique credentials, which helps prevent unauthorized access and ensures that only registered voters can participate in the election.

The voting module allows voters to select their preferred candidate and submit their vote through the web interface. Once the vote is submitted, the system securely stores the voting data in the cloud database.

The database module maintains information related to voters, candidates, and vote records. It ensures that each voter can vote only once and prevents duplicate voting. Additionally, the system updates vote counts automatically when a vote is successfully recorded.

The entire system operates on a serverless cloud environment, which allows automatic scaling based on the number of users accessing the system. This architecture reduces infrastructure management and improves system reliability during high voting traffic.proposed e-voting system maintains confidentiality, integrity, and reliability throughout the voting process.

VII. RESULTS AND DISCUSSION

The proposed serverless cloud-based e-voting system was successfully implemented and tested across all functional modules. System testing was conducted to ensure the correctness of individual components, while integration testing verified seamless interaction between authentication, voting, and data storage mechanisms. The system demonstrated reliable performance, secure vote handling, and real-time data processing capabilities using google cloud platform.

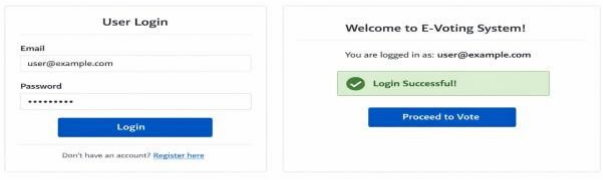
A. User authentication and authorization

The authentication module was implemented to ensure that only authorized users can access the voting system. Users were able to register and log in securely using valid credentials. The system successfully validated user identity and maintained session control throughout the voting process. Unauthorized access attempts were restricted, ensuring that only authenticated users could proceed to the voting interface.

Table I

System implementation parameters

Parameter	Description
ackend	Python (flask framework)
Database	Cloud Firestore
Frontend	Html5, Css3, Javascript
Authentication	Firebase Autentication
Architecture	Serveless Cloud architecture
Development tools	Vs Code, Web Browser
Cloud Platform	Google Cloud Platform



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VIII. SECURITY ANALYSIS

Security is a critical aspect of any electronic voting system to ensure transparency, reliability, and trust in the election process.

In addition, each vote is securely stored in the cloud database with a unique identifier to ensure data integrity and prevent any modification or duplication of votes. The system also prevents multiple voting by updating the voting status of each voter immediately after a vote is successfully submitted. Secure communication between the client interface and cloud services protects sensitive voter information during transmission.

Furthermore,theserverless infrastructure provided by**google cloud offers built-in security features such as authentication control, secure data storage, and reliable system performance. These mechanisms collectively ensure that the Fig. 2. User Login & Authentication Interface

B. Voting process and vote casting

The voting module was tested to verify accurate vote casting functionality. Users were able to select their preferred candidate through a user-friendly interface and successfully cast their vote. Each vote was recorded in the cloud database without data loss or duplication during normal operation. The system ensured that vote transactions were processed efficiently, and confirmation messages were displayed upon successful vote submission.

B. Voting Process and Vote Casting

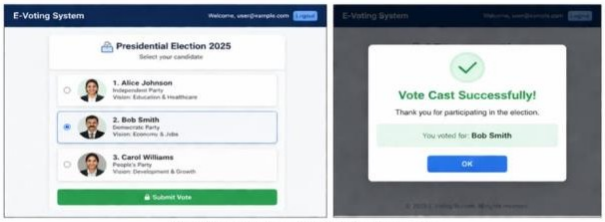

Fig. 2. Voting Interface and Vote Casting Confirmation

Users can select their preferred candidate and successfully cast their vote through a user-friendly interface.

C. Duplicate vote prevention mechanism

A vote restriction mechanism was implemented to ensure that each user could cast only one vote. The system verified the voting status of each user before allowing vote submission. If a user attempted to vote more than once, the system displayed an appropriate alert message and prevented duplicate vote entries. This feature significantly improved the integrity and fairness of the election process.

C. Duplicate Vote Prevention Mechanism

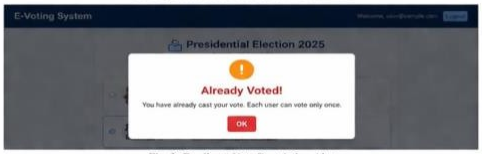

Fig. 3. Duplicate Vote Restriction Alert

The system prevents multiple voting by verifying the user's voting status before allowing vote submission.

D. Real-time vote storage and result generation

The system utilized a cloud-based database to store votes in real time. Each vote was instantly updated in the database, allowing accurate and up-to-date vote counts. The result module dynamically retrieved vote data and displayed the total votes for each candidate. This real-time processing capability ensured transparency and eliminated delays in result generation.

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D. Real-Time Vote Storage and Result Generation

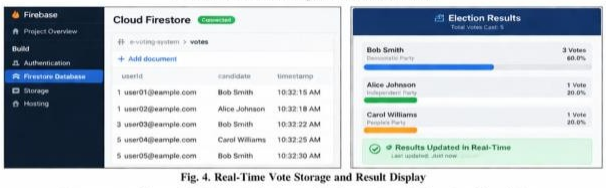

Fig. 4. Real-Time Vote Storage and Result Display

Votes are stored instantly in the cloud database and results are dynamically updated in real time.

E. System performance and reliability

The overall system performance was evaluated under multiple voting scenarios. The system handled concurrent vote submissions efficiently without performance degradation. Cloud infrastructure ensured high availability and scalability, allowing the system to support multiple users simultaneously. The application maintained consistent response times and reliable operation during testing.

E. System Performance and Reliability

Fig. 5. System Performance under Multiple Voting Conditions

The system maintains stable performance and consistent response during multiple user interactions.

IX. CONCLUSION

This paper presented a serverless cloud-based e-voting system designed to provide a secure, scalable, and efficient platform for conducting digital elections. By utilizing the capabilities of google cloud platform, the proposed system eliminates the need for traditional server management while ensuring high availability and reduced operational complexity. The implementation demonstrates that cloud-based solutions can effectively handle real-time voting processes with reliability and performance.The system incorporates secure user authentication and vote management mechanisms to ensure that only authorized users can participate and that each voter is allowed to cast a single vote. The use of a cloud-based database ensures secure storage of voting data and supports real-time vote recording and result generation. Experimental observations indicate that the system maintains data integrity, prevents unauthorized access, and delivers consistent performance under varying conditions.

Overall, the proposed e-voting system provides a practical andcost-effective solution for modern electronic elections. It can be effectively deployed in academic institutions, organizations, and small-scale governance scenarios, contributing to the advancement of secure and efficient digital voting technologies.

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